

**Design, Analysis, and Experimental Verification of a Mechanically Compliant
Interface for Fabricating Reliable, Double-Side Cooled, High-Temperature,
Sintered Silver Interconnected Power Modules**

David W. Berry

Dissertation submitted to the faculty of
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Materials Science and Engineering

Guo-Quan Lu, Chair
Khai D.T. Ngo, Co-chair
Alex O. Aning
Louis J. Guido

August 13th, 2014
Blacksburg, Virginia

Keywords: Three-dimensional packaging, double-side cooled, planar, power module packaging, thermal resistance, thermal impedance, sintered silver, quarter-bridge, half-bridge.

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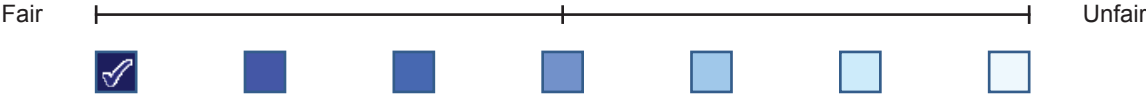
Fair Use Evaluation Documentation

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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Transient liquid phase (TLP) bonding for microsystem packaging applications
Copyright Holder:	W. Welch, III, C. Junseok, L. Sang-Hyun, N. Yazdi, and K. Najafi
Publication Status:	Published
Publisher:	Solid-State Sensors, Actuators and Microsystems, 2005
Place of Publication:	Solid-State Sensors, Actuators and Microsystems, 2005 Digest of Technical Papers. TRANSDUCERS '05. The 13th International Conference on, 2005
Publication Year:	2005
Description of Work:	journal article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

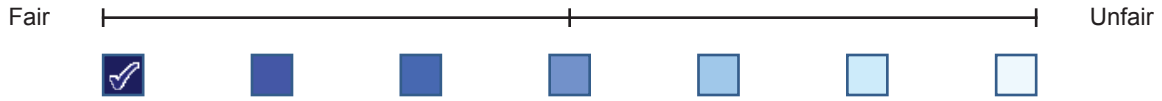
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"



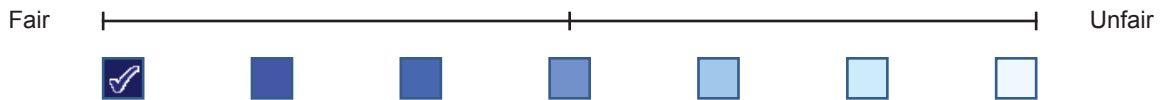
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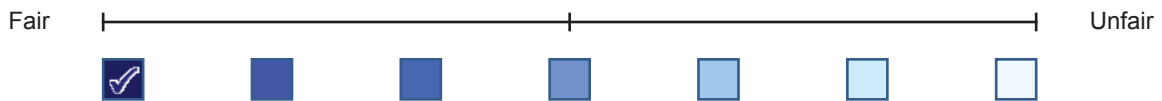
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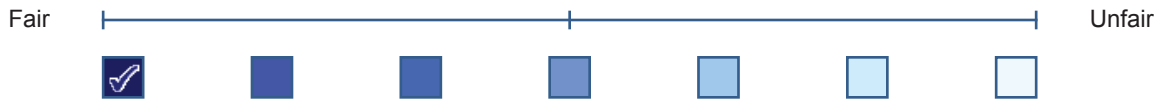
[+] Proper attribution will be given with the intended use



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



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Signature: David Berry

Date of Signature: 5/20/14

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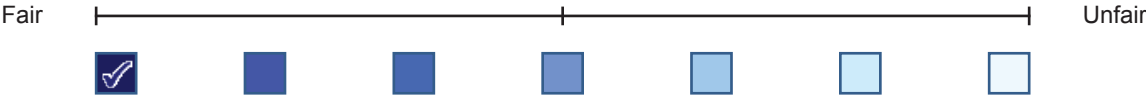
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Polytechnic Institute and State University
Title of Work Used:	Reliability assessment of sintered nano-silver die attachment for power semiconductors
Copyright Holder:	M. Knoerr, S. Kraft, and A. Schletz
Publication Status:	Published
Publisher:	Electronics Packaging Technology Conference (EPTC)
Place of Publication:	Electronics Packaging Technology Conference (EPTC)
Publication Year:	2010
Description of Work:	Reliability assessment of sintered nano-silver die attachment for power semiconductors
Date of Evaluation:	August 21, 2014
Date of Intended Use:	August 21, 2014

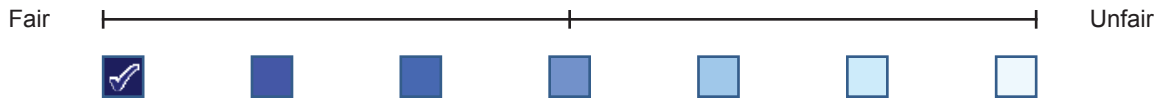
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[+] Use is one-time, or is only occasional or spontaneous



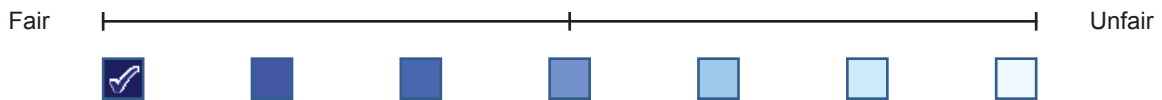
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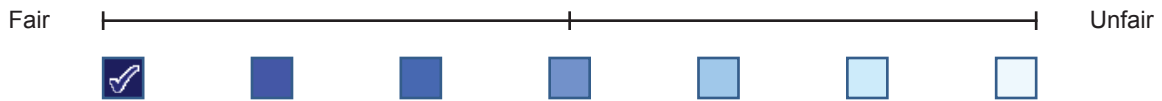
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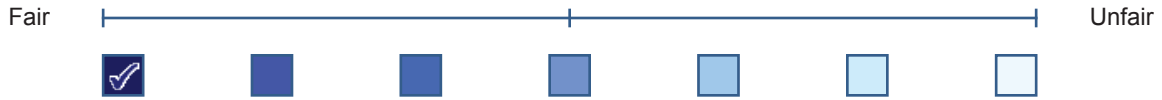
[+] Use of the work has the potential to create or improve the market for the work
[+] The copy of the work to be used is a legal copy



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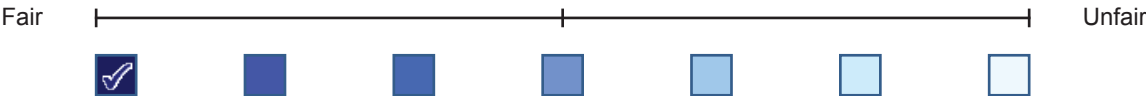
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Ageing and Failure Modes of IGBT Modules in High-Temperature Power Cycling
Copyright Holder:	V. Smet, F. Forest, J. J. Huselstein, F. Richardeau, Z. Khatir, S. Lefebvre, and M. Berkani
Publication Status:	Published
Publisher:	Industrial Electronics, IEEE Transactions on,
Place of Publication:	Industrial Electronics, IEEE Transactions on, vol. 58, pp. 4931-4941, 2011
Publication Year:	2011
Description of Work:	journal article
Date of Evaluation:	May 20, 2014
Date of Intended Use:	May 20, 2014

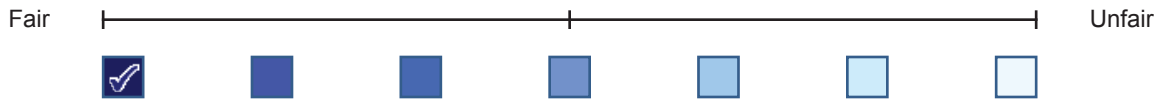
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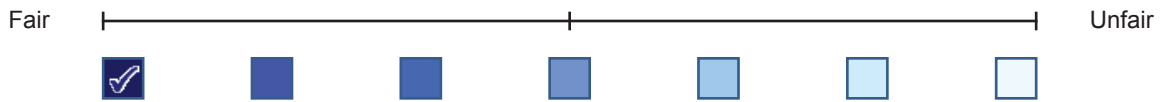
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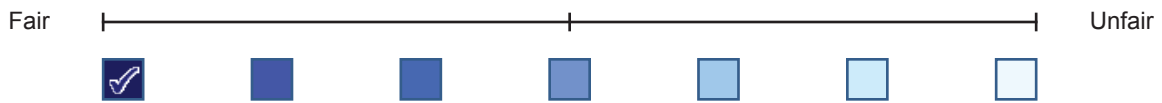
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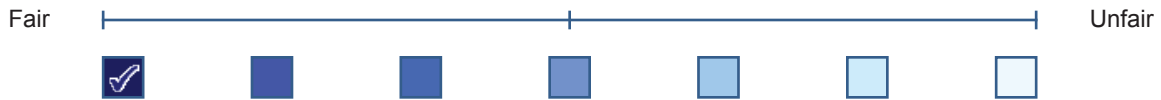
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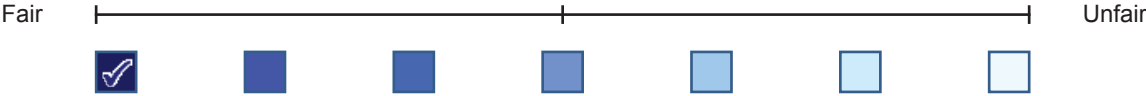
Fair Use Evaluation Documentation

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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Electronic Components and Technology Conference (ECTC)
Copyright Holder:	J. Sylvester.
Publication Status:	N/A
Publisher:	Electronic Components and Technology Conference (ECTC)
Place of Publication:	Electronic Components and Technology Conference (ECTC)
Publication Year:	2012
Description of Work:	journal article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

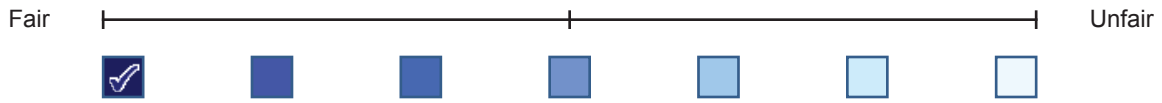
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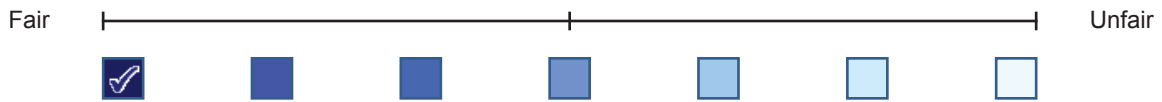
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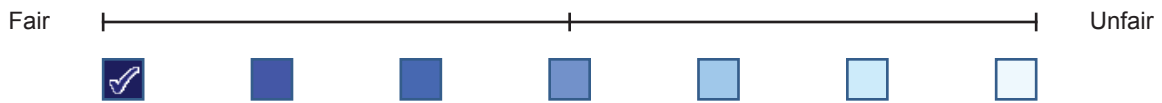
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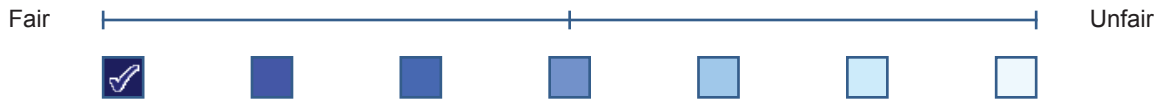
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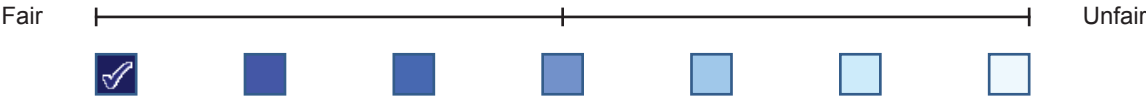
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Metal Posts Interconnected Parallel Plate Structure (MPIPPS)
Copyright Holder:	unknown
Publication Status:	Published
Publisher:	www.cpes.vt.edu
Place of Publication:	www.cpes.vt.edu
Publication Year:	unknown
Description of Work:	image from webpage
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

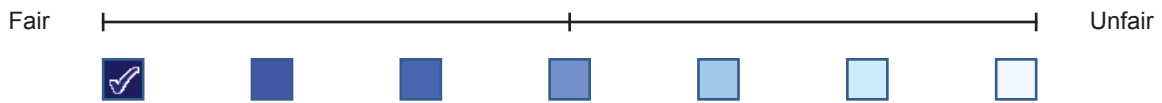
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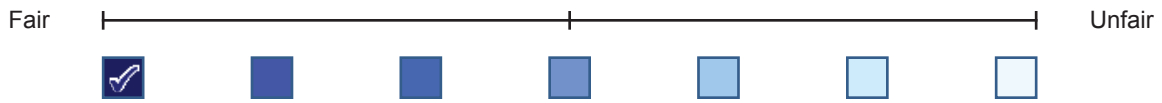
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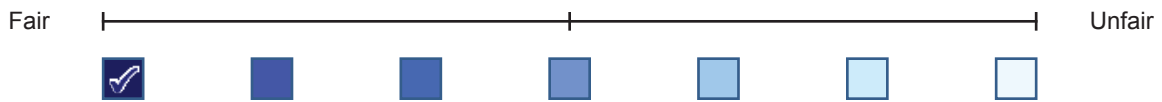
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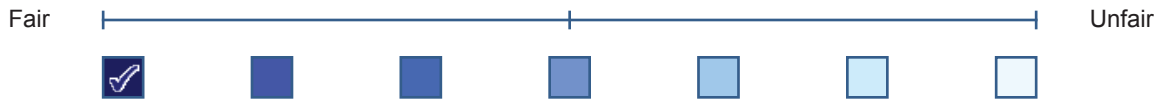
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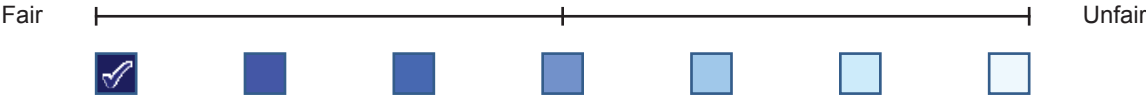
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Reliable Integration of Double-Sided Cooled Stacked Power Switches based on 70 micrometer Thin IGBTs and Diodes
Copyright Holder:	J. F. Li, A. Castellazzi, A. Solomon, and C. M. Johnson
Publication Status:	Published
Publisher:	Integrated Power Electronics Systems (CIPS), 2012 7th International Conference on, 2012
Place of Publication:	Integrated Power Electronics Systems (CIPS), 2012 7th International Conference on, 2012
Publication Year:	2012
Description of Work:	journal article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

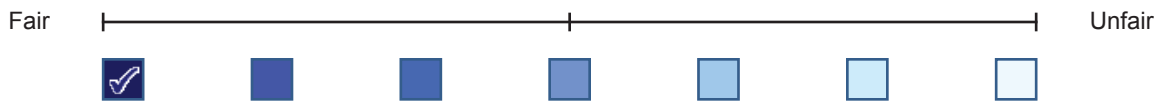
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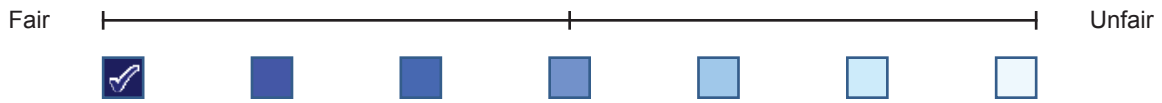
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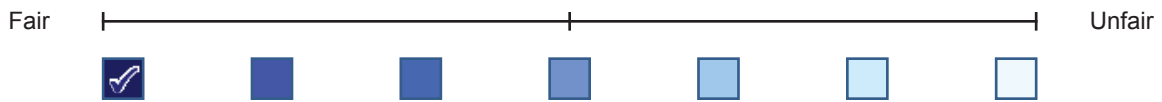
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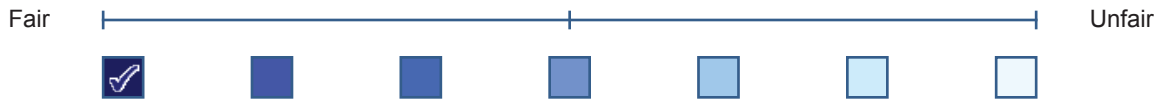
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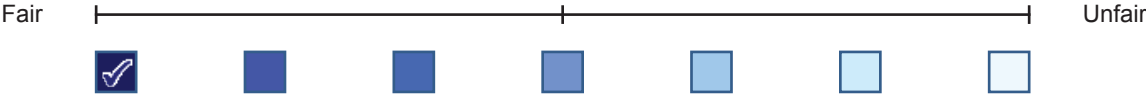
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Polytechnic Institute and State University
Title of Work Used:	New structure of power integrated module
Copyright Holder:	M. Mermet-Guyennet
Publication Status:	Published
Publisher:	Integrated Power Systems (CIPS)
Place of Publication:	Integrated Power Systems (CIPS)
Publication Year:	2006
Description of Work:	New structure of power integrated module
Date of Evaluation:	August 21, 2014
Date of Intended Use:	August 21, 2014

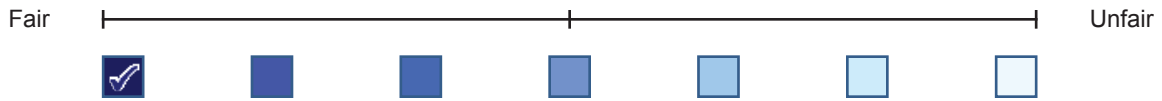
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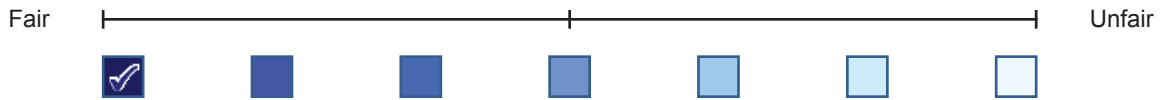
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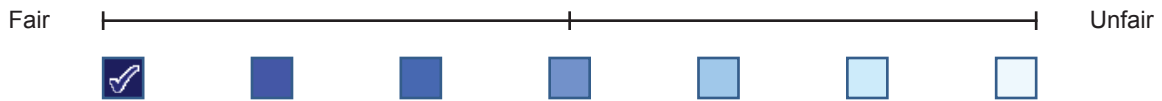
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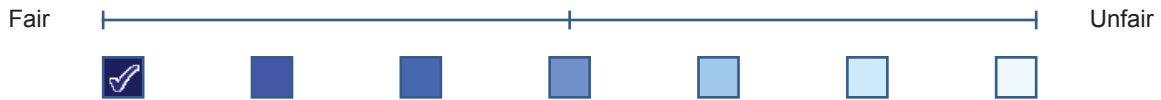
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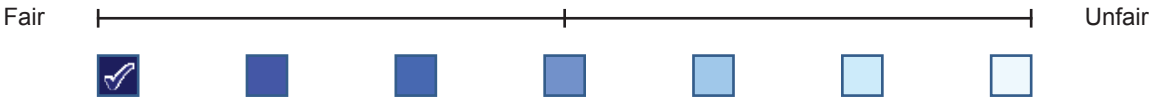
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Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	POWER MODULE PACKAGING WITH DOUBLE SIDED PLANAR INTERCONNECTION AND HEAT EXCHANGERS," 2013.
Copyright Holder:	Z. X. Liang, Martino, L., Ning, P., Wang, F
Publication Status:	Published
Publisher:	webpage patentdocs
Place of Publication:	http://www.faqs.org/patents/app/20130020694
Publication Year:	2013
Description of Work:	patent application for new device
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

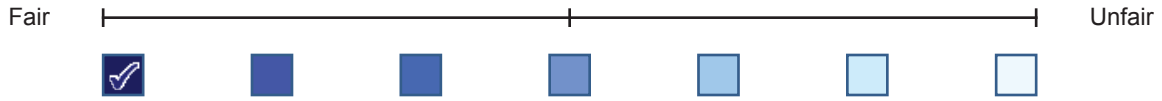
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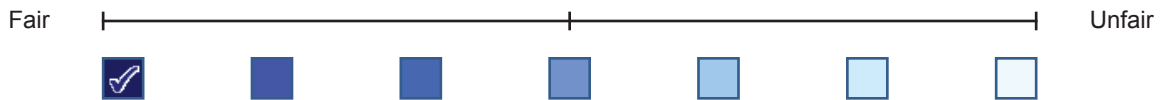
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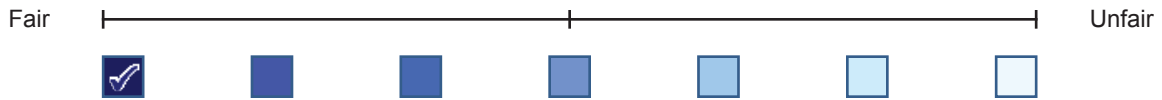
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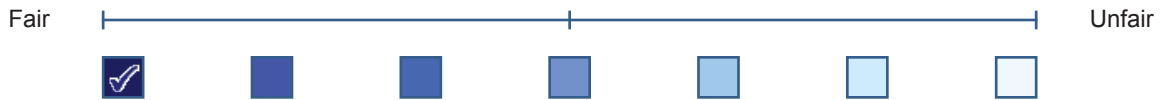
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Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 5/20/14

***Disclaimer:** This document is intended to help you collect, organize & archive the information you might need to support your fair use evaluation. It is not a source of legal advice or assistance. The results are only as good as the input you have provided by are intended to suggest next steps, and not to provide a final judgment. It is recommended that you share this evaluation with a copyright specialist before proceeding with your intended use.

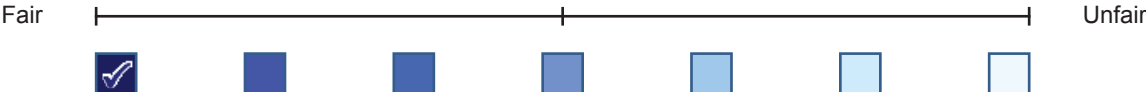
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	POWER MODULE PACKAGING WITH DOUBLE SIDED PLANAR INTERCONNECTION AND HEAT EXCHANGERS," 2013.
Copyright Holder:	Z. X. Liang, Martino, L., Ning, P., Wang, F
Publication Status:	Published
Publisher:	webpage patentdocs
Place of Publication:	http://www.faqs.org/patents/app/20130020694
Publication Year:	2013
Description of Work:	patent application for new device
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

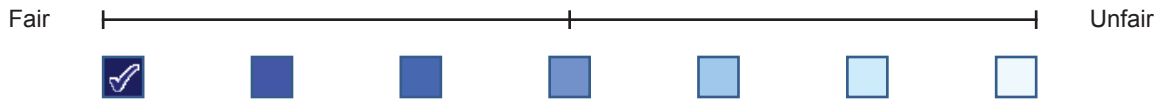
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is transformative, i.e. it uses the existing work in a new way (creates an index to the work) or for a new purpose (parody, pastiche, instructional materials, etc.) Transformative works are favored because the purpose of U.S. Copyright Law is to encourage the development and dissemination of new knowledge to benefit the public and thereby advance learning.



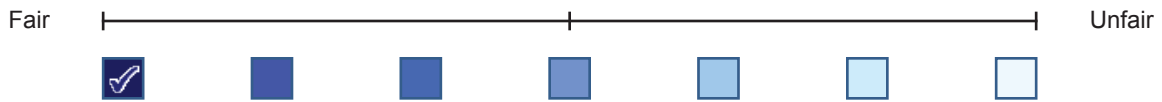
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used is primarily of a factual nature (non-fiction, collection of facts, etc.)



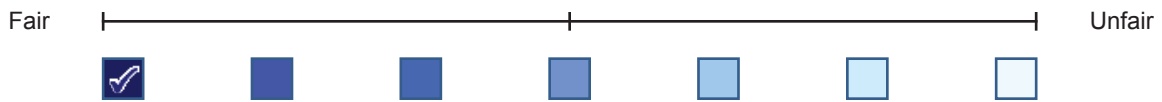
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

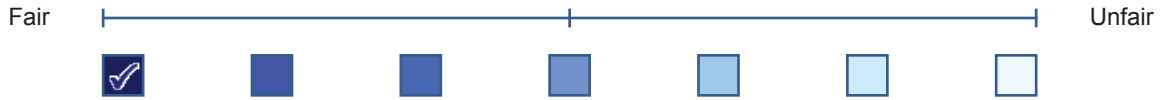
[+] Proper attribution will be given with the intended use
[+] The copy of the work to be used is a legal copy



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 5/20/14

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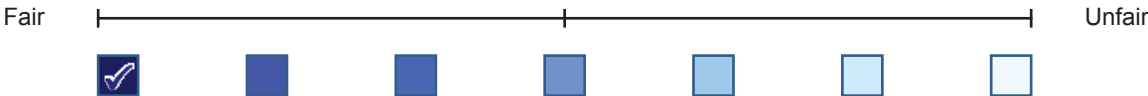
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Processing and Characterization of a 100% Low-Temperature Ag-Sintered Three-Dimensional Structure
Copyright Holder:	A. Masson, S. Azzopardi, F. Le Henaff, J. Y. Deletage, E. Woigard, S. Bontemps, and J. Joguet
Publication Status:	Published
Publisher:	Power Electronics and Applications (EPE), 2013 15th European Conference on, 2013
Place of Publication:	Power Electronics and Applications (EPE), 2013 15th European Conference on, 2013
Publication Year:	2013
Description of Work:	conference article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

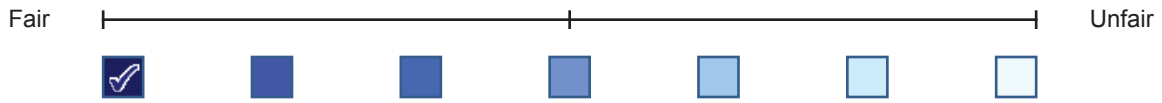
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[+] Use is transformative, i.e. it uses the existing work in a new way (creates an index to the work) or for a new purpose (parody, pastiche, instructional materials, etc.) Transformative works are favored because the purpose of U.S. Copyright Law is to encourage the development and dissemination of new knowledge to benefit the public and thereby advance learning.



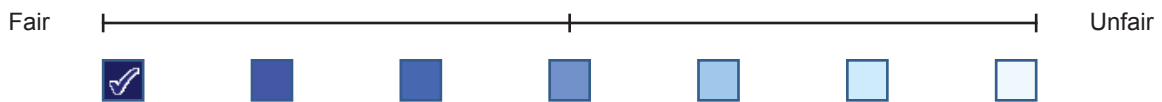
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used has been previously PUBLISHED



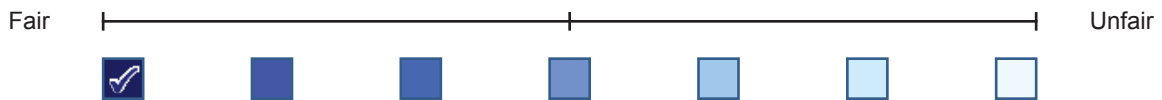
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

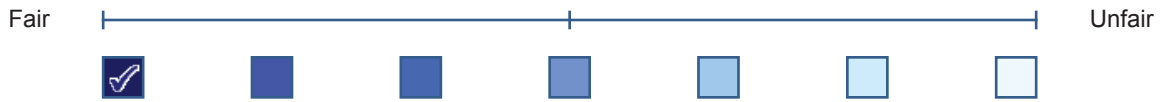
[+] Proper attribution will be given with the intended use
[+] The copy of the work to be used is a legal copy



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Signature: David Berry

Date of Signature: 5/20/14

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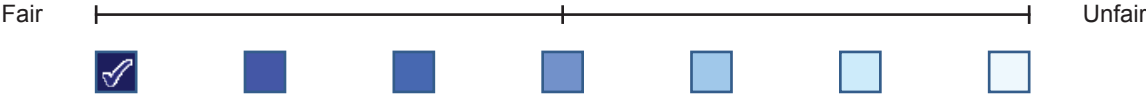
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Creep Behavior of Sintered Nanosilver Paste
Copyright Holder:	Kewei Xiao
Publication Status:	Unpublished
Publisher:	
Place of Publication:	
Publication Year:	
Description of Work:	research article-never published
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

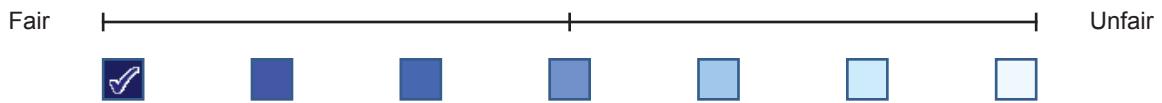
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)
[+] Use is one-time, or is only occasional or spontaneous



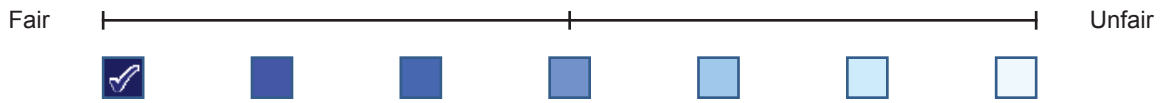
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used contains limited new knowledge, content, or creative expression (in relation to previously copyrighted works)



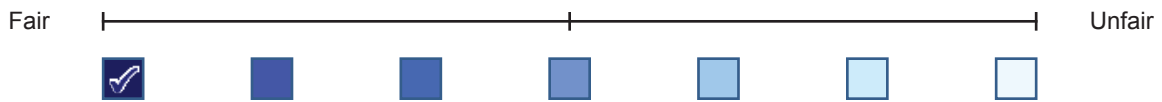
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

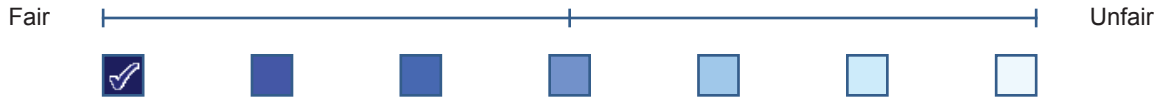
[+] Proper attribution will be given with the intended use



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[see tool disclaimer for important clarifying information]:



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Signature: David Berry

Date of Signature: 5/20/14

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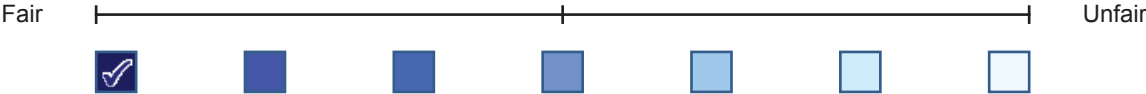
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Polytechnic Institute and State University
Title of Work Used:	Study of Robustness for Double-Sided Module with Rigid Substrates on Both Sides
Copyright Holder:	J. Li, G. Q. Lu, and K. Ngo
Publication Status:	N/A
Publisher:	Center for Power Electronics
Place of Publication:	Center for Power Electronics Annual Conference
Publication Year:	2012
Description of Work:	Conference Paper
Date of Evaluation:	August 21, 2014
Date of Intended Use:	August 21, 2014

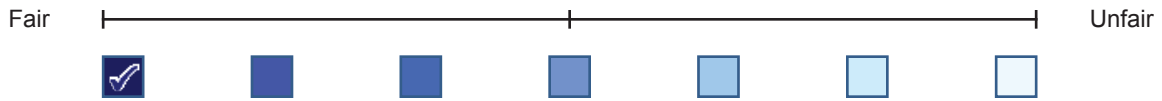
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)
[+] Use is one-time, or is only occasional or spontaneous



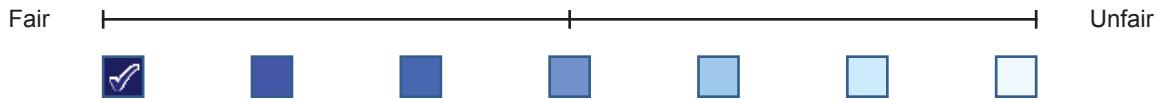
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used is primarily of a factual nature (non-fiction, collection of facts, etc.)
[+] Work to be used contains limited new knowledge, content, or creative expression (in relation to previously copyrighted works)



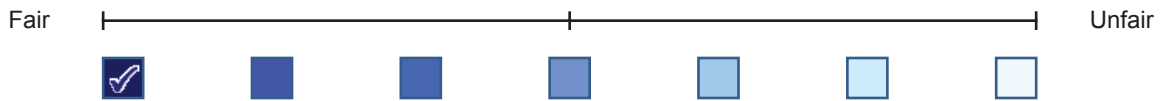
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used
[+] The amount used falls within widely recognized fair use guidelines* vetted by key stakeholder groups [reference guidelines]



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

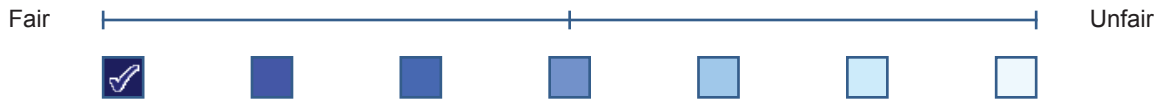
[+] Use of the work has the potential to create or improve the market for the work
[+] The copy of the work to be used is a legal copy



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 8/21/14

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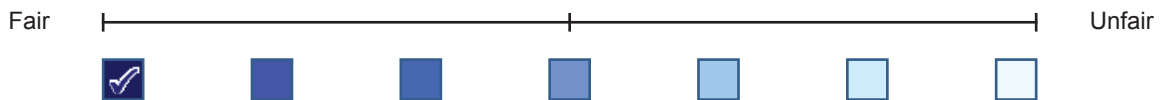
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Image of product from webpage
Copyright Holder:	Micross
Publication Status:	Published
Publisher:	Micross webpage
Place of Publication:	webpage
Publication Year:	unknown
Description of Work:	picture of current state of art power modules
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

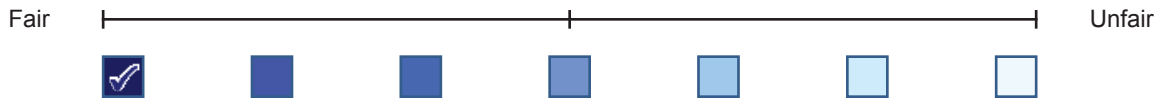
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"
[+] Use is one-time, or is only occasional or spontaneous
[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)



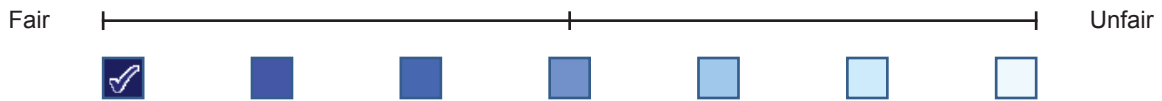
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used has been previously PUBLISHED
[+] Work to be used contains limited new knowledge, content, or creative expression (in relation to previously copyrighted works)



Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

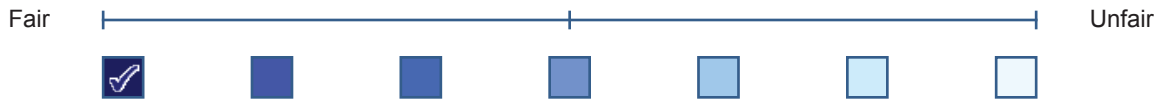
[+] Proper attribution will be given with the intended use



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 5/20/14

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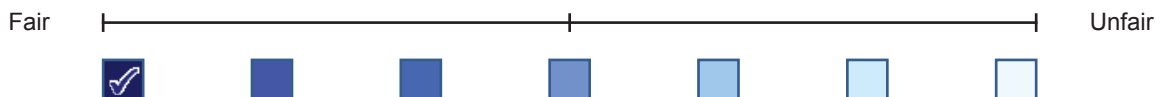
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	IGBT Applications Handbook
Copyright Holder:	On Semiconductor
Publication Status:	Published
Publisher:	On Semiconductor
Place of Publication:	www.on-semi.com
Publication Year:	2012
Description of Work:	handbook
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

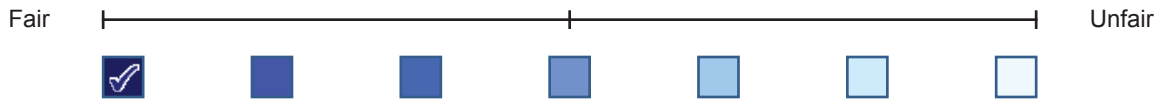
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[+] Use is clearly defined and is restricted in scope (limited duration, not iterative, restricted access, etc.)
[+] Use is one-time, or is only occasional or spontaneous



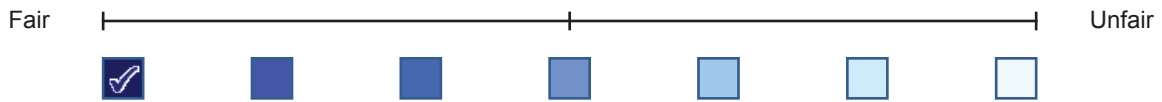
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used has been previously PUBLISHED



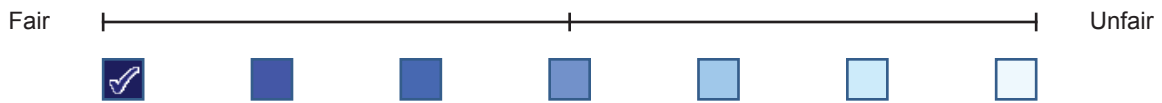
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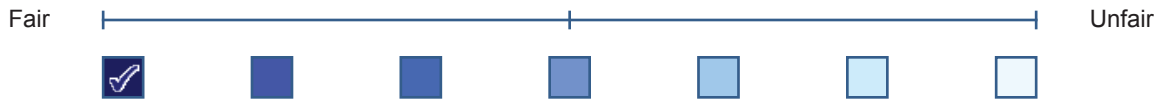
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The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



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Signature: David Berry

Date of Signature: 5/20/14

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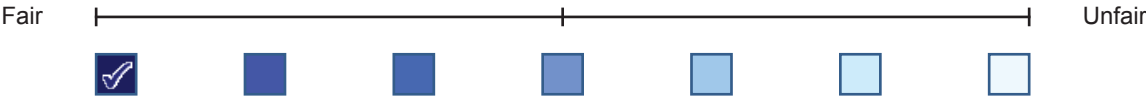
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	JEDEC Standard JESD51-14
Copyright Holder:	Joint Electron Device Engineering Council
Publication Status:	Published
Publisher:	Joint Electron Device Engineering Council
Place of Publication:	JEDEC.org
Publication Year:	2012
Description of Work:	standard and documentation on its use
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

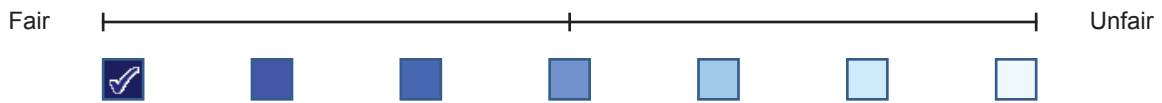
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[+] Use is one-time, or is only occasional or spontaneous
[+] Use is for "criticism, comment, news reporting, teaching, (including multiple print copies for classroom use), scholarship or research"



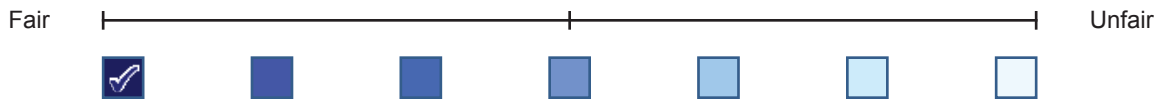
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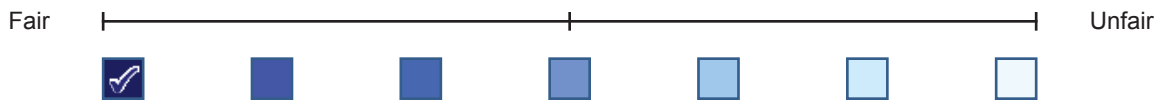
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Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

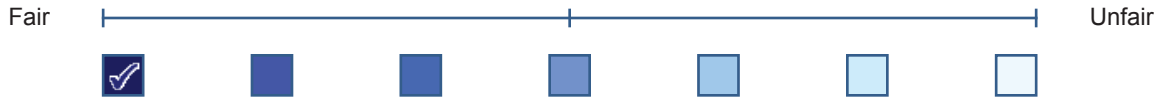
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Signature: David Berry

Date of Signature: 5/20/14

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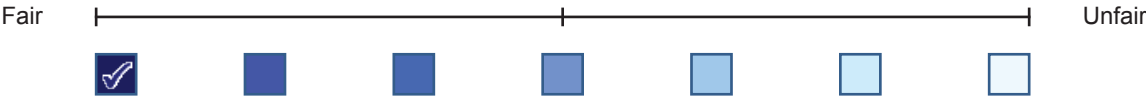
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	JEDEC Standard JESD51-14
Copyright Holder:	Joint Electron Device Engineering Council
Publication Status:	Published
Publisher:	Joint Electron Device Engineering Council
Place of Publication:	JEDEC.org
Publication Year:	2012
Description of Work:	standard and documentation on its use
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

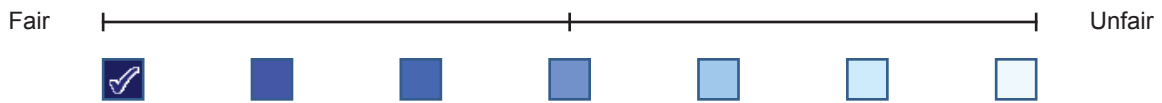
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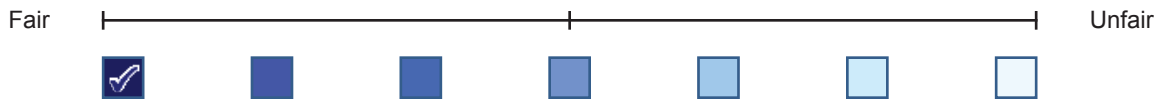
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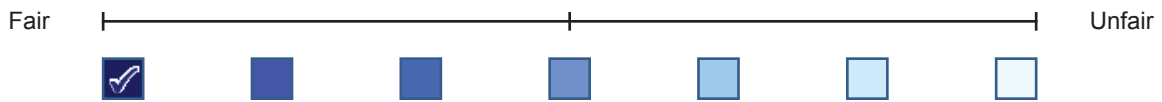
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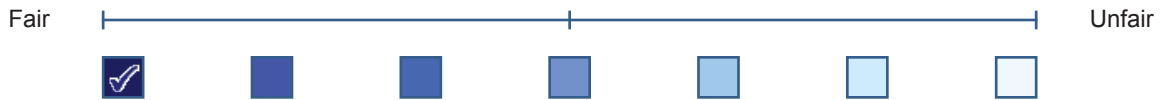
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[see tool disclaimer for important clarifying information]:



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Signature: David Berry

Date of Signature: 5/20/14

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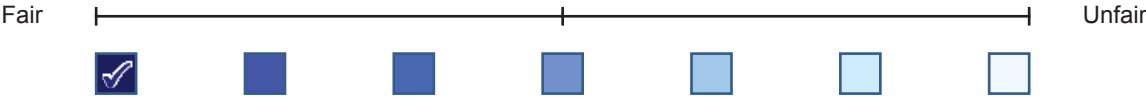
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Applying Anand model to low-temperature sintered nanoscale silver paste chip attachment
Copyright Holder:	D.-j. Yu, X. Chen, G. Chen, G.-q. Lu, and Z.-q. Wang
Publication Status:	Published
Publisher:	Materials & Design
Place of Publication:	Materials & Design vol. 30
Publication Year:	2009
Description of Work:	journal article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

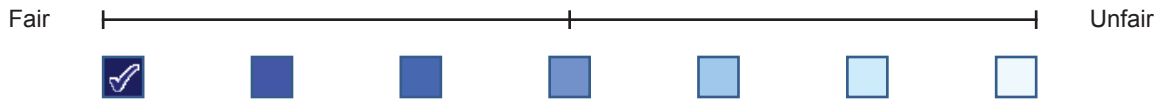
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is socially beneficial (promotes the creation of new knowledge, learning, etc.) [define how]



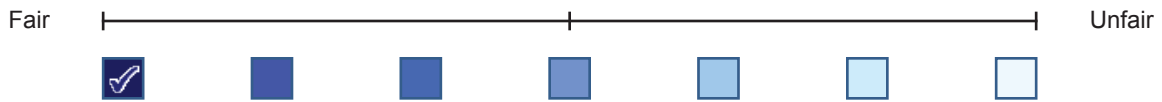
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used has been previously PUBLISHED



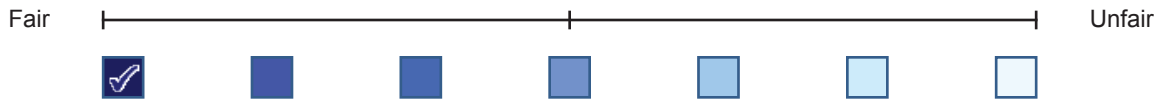
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

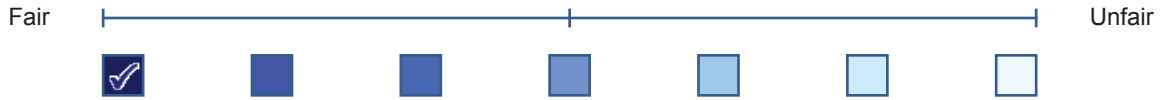
[+] Proper attribution will be given with the intended use



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 5/20/14

***Disclaimer:** This document is intended to help you collect, organize & archive the information you might need to support your fair use evaluation. It is not a source of legal advice or assistance. The results are only as good as the input you have provided by are intended to suggest next steps, and not to provide a final judgment. It is recommended that you share this evaluation with a copyright specialist before proceeding with your intended use.

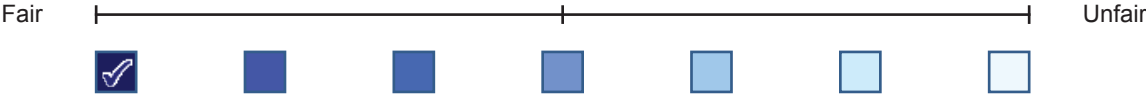
Fair Use Evaluation Documentation

Compiled using the **Fair Use Evaluator** [cc] 2008 Michael Brewer & the Office for Information Technology Policy, <http://librarycopyright.net/fairuse/>

Name:	David Berry
Job Title:	Graduate Student
Institution:	Virginia Tech Department of Materials Science and Engineering
Title of Work Used:	Transient Thermal Performance of IGBT Power Modules Attached by Low-Temperature Sintered Nanosilver
Copyright Holder:	C. Gang, H. Dan, M. Yun-Hui, C. Xiao, W. Tao, C. Xu, and L. Guo-Quan
Publication Status:	Published
Publisher:	Device and Materials Reliability, IEEE Transactions on
Place of Publication:	Device and Materials Reliability, IEEE Transactions on vol. 12, pp. 124-132, 2012.
Publication Year:	2012
Description of Work:	journal article
Date of Evaluation:	May 19, 2014
Date of Intended Use:	May 19, 2014

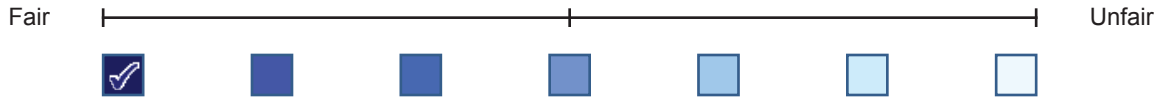
Describe the **Purpose** and Character of Your Intended Use:

[+] Use is not-for-profit
[+] Use is one-time, or is only occasional or spontaneous



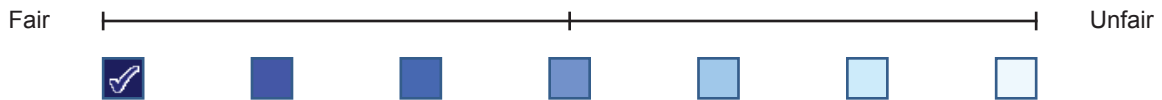
Describe the **Nature** of Your Intended Use of the Copyrighted Work:

[+] Work to be used has been previously PUBLISHED



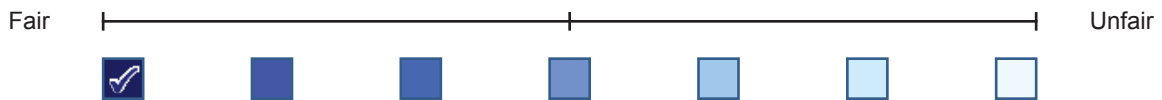
Describe the **Amount** of Your Intended Use in Relation to the Copyrighted Work as a Whole:

[+] Only limited and reasonable portions will be used



Describe the **Effect** of Your Intended Use on the Potential Market or Value of the Copyrighted Work:

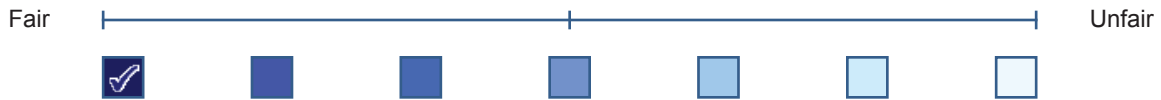
[+] The copy of the work to be used is a legal copy
[+] Proper attribution will be given with the intended use



The Average **"Fairness Level,"** Based on Your Rating of Each of the 4

Factors, Is:

[see tool disclaimer for important clarifying information]:



Based on the information and justification I have provided above, I, David Berry, am asserting this use is **FAIR** under Section 107 of the U.S. Copyright Code.

Signature: David Berry

Date of Signature: 5/20/14

***Disclaimer:** This document is intended to help you collect, organize & archive the information you might need to support your fair use evaluation. It is not a source of legal advice or assistance. The results are only as good as the input you have provided by are intended to suggest next steps, and not to provide a final judgment. It is recommended that you share this evaluation with a copyright specialist before proceeding with your intended use.